CHAPTER 3

Rubber Bands and Springs – Catapults 1914–15

The catapult is an ancient weapon. The use of torsion-powered artillery was a Greek invention and widely used by the Romans from at least the time of the Punic Wars 264–241 BC. There were two sorts of weapon that used this form of propulsion: weapons that fired arrows in a straight trajectory, a form of crossbow; and stone-throwers that used a rotating arm to propel a projectile in a vertical arc. They were quite sophisticated and effective pieces of equipment for their day. Reconstructions in the early years of this century by academics showed that they worked every bit as well as the fourth-century AD accounts of Vegetius suggested. Twisted ropes made of materials with elastic properties, such as animal sinew and horsehair, an art that has been lost, provided the torsional energy. By the twentieth century, of course, the elastic properties of natural rubber were well known even to small boys familiar with the simple catapult made from a Y-shaped twig and a piece of elastic stretched between the arms. Catapults and stone-throwers belonged to another age and mischievous boys.

They made a remarkable comeback in 1914 and 1915, like ageing stars who still had a thing or two to show the youngsters, and made a small but significant contribution to trench warfare. That they were treated seriously by the Army is perhaps a little surprising but severe shortages of trench mortars meant that it had to take what it could get. The need for bomb-throwing ordnance was not being satisfied by the trickle of trench mortars reaching the front during late 1914 and servicemen and civilians alike searched for alternatives. By mid-1915 there were about 750 catapults and bomb-throwers in France. Although it may seem obvious with the benefit of hindsight, there was nothing obvious about returning to the ancients for inspiration. Making a catapult or a bomb-thrower that used some form of mechanical action to hurl a bomb a reasonable distance with some degree of accuracy is not as simple as it sounds. In some ways, it is much more difficult to make a catapult that will hurl a bomb accurately over a given distance, and do so consistently, than it is to make a mortar to do the same thing. That a few emerged as effective engines of modern war was a remarkable achievement for their inventors and designers. Irrespective of the qualities of Roman artillery, they were not expected to perform with the accuracy and precision of a piece of twentieth-century ordnance.

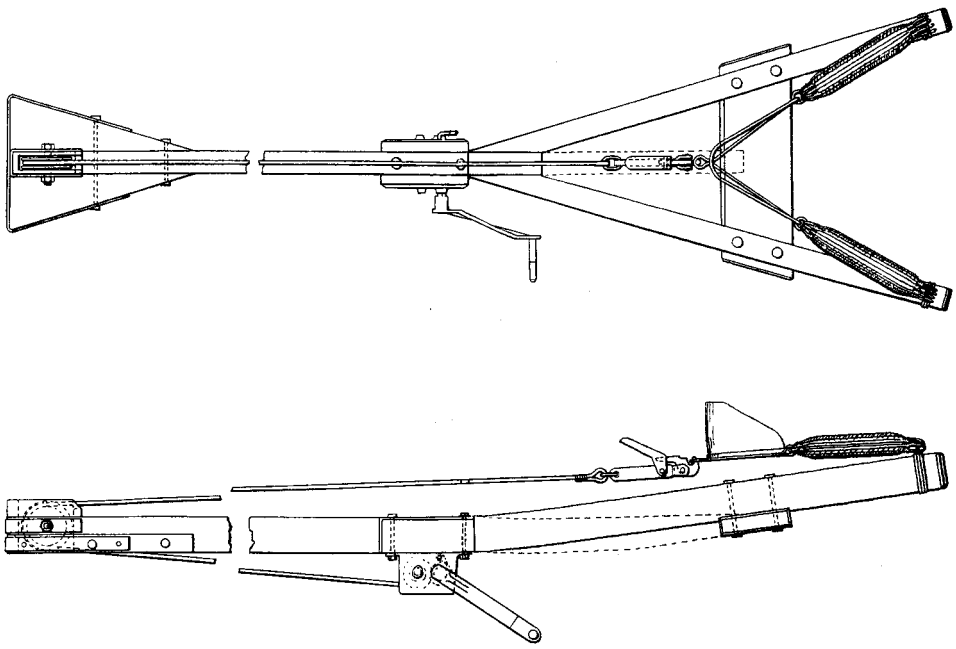
Simply copying what the Romans had done 2,000 years earlier was no guarantee of success. Considering the reconstructions of Roman artillery undertaken around the time of the First World War it is not surprising that someone in academia should put two and two together and suggest a Roman catapult as a suitable weapon with which to bombard the Germans in their trenches. A Cambridge history professor prepared drawings and copious notes which he sent to the commanding officer of a battalion of the Cambridgeshire Regiment, stationed at Ploegsteert Wood, Ypres. They were acquaintances and the professor thought he was doing the battalion a favour. The commander was sufficiently impressed to be persuaded to have a catapult built according to the instructions he was sent. This was no

simple matter as suitable timber of the right size had to be found, but it was done and the catapult was dug in at a suitable location in readiness. It was evidently 7 ft long and weighed more than a quarter of a ton.

When they came to fire this thing, all their labours of several days and nights came to nothing. The bombs they tried to fling at the Germans either failed to travel any distance, and certainly not as far as the German trenches, or the bombs went straight up in the air and dropped back on to the catapult operators. Although this may have been partly due to the inexperience of the operators, faulty construction or faulty plans, this was to become a common drawback of all bomb-throwers and catapults. Simple, catapults may have looked, but simple to use they were not. The professor's catapult was evidently torn up for firewood.

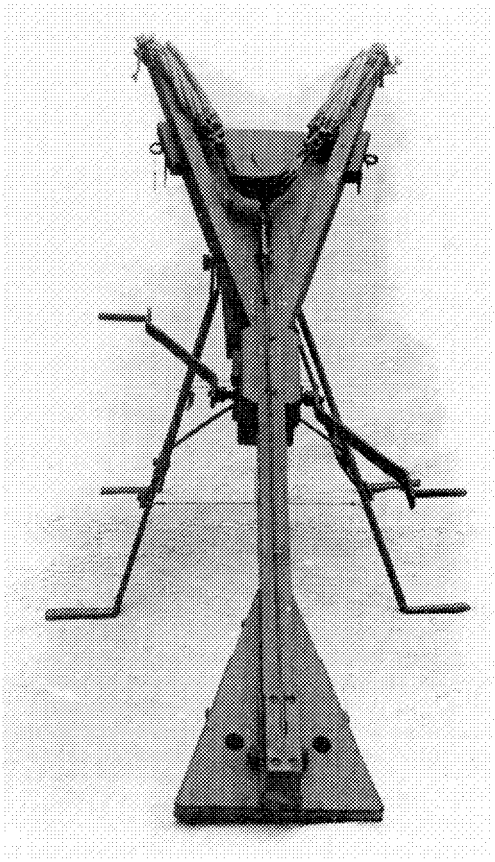
This amateur attempt at constructing a workable catapult was neither the first nor the last time a catapult was contemplated by the Army as a viable engine of war. A much better machine was brought to Louis Jackson in October 1914. Unlike the Cambridgeshires' Roman copy, this one was a version of the device so well known to small boys, only bigger and more powerful. A gentleman by the name of Claude Pemberton Leach of South Kensington brought the catapult to Jackson for his approval. Leach claimed that it could throw a golf ball 200 yd, which was not much of a recommendation since a bomb weighed more than a golf ball and 200 yd was no distance at all. However, Jackson saw potential in the device and suggested that Leach strengthen it and carry out endurance trials with the rubber springs which powered the catapult. Leach did what he could and succeeded in getting the contraption to throw a 2 lb weight 200 yd with a remarkable degree of accuracy.

Leach evidently also took his catapult to Gamage's department store, 'Cycling, Sports and General Outfitters', and together they applied for a patent on 22 May 1915 which was



The Leach/Gamage catapult from UK patent 7,710/15. Note the pawl on the winding box in the top drawing. This was used to lock the winding gears. Note also the trigger mechanism behind the pouch.

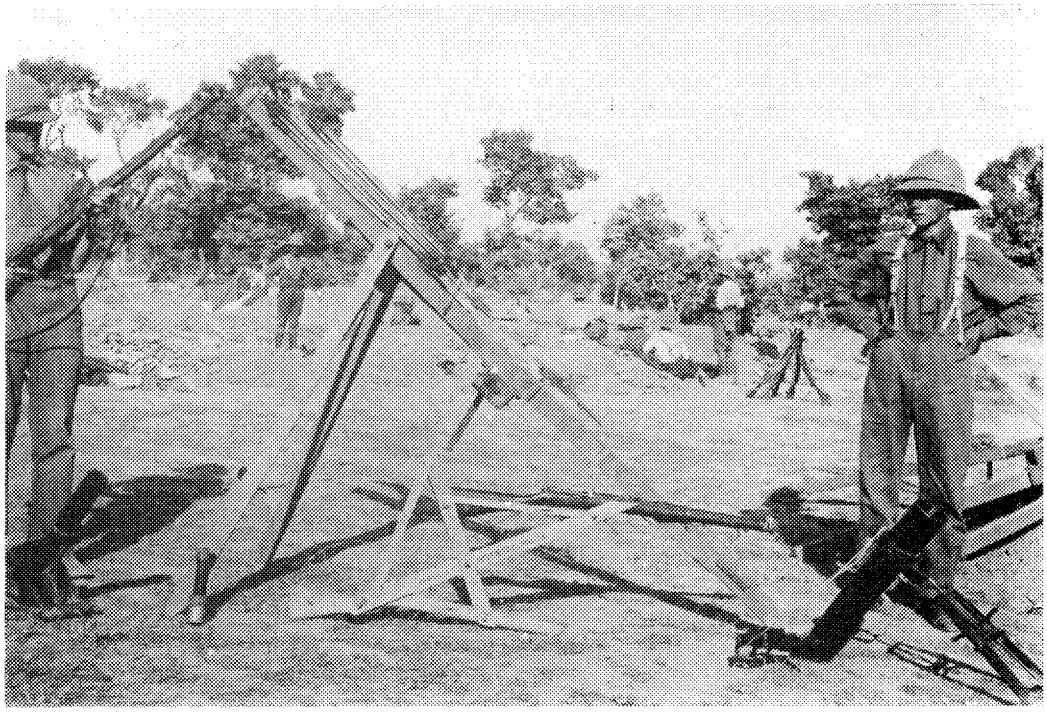
subsequently granted as 7,710/15 one year later. That there was a delay of about eight months between Leach taking his catapult to Jackson and the patent application being filed, together with the fact that Gamage's was co-patentee, strongly suggests that his catapult was significantly developed by Gamage's. There is a very close resemblance between the patent drawings and the devices used in France. However, it is clear that the catapult was being used in France some time before the patent application (although this, in itself, signifies very little since the patent laws of that time would have permitted the device to be used outside the UK without prejudicing any future application in this country). Since the catapult was built by Gamage's factory, there was no question of the government having to pay royalties. The catapult was also used in the Dardanelles; these were not built by Gamage's but by the engineers of the No. 2 Field Company, Royal Naval Division. Since the catapults are so alike, No. 2 Field Company must have been supplied with drawings; the devices are not locally made improvisations.



The Leach or Gamage catapult with double winding handles and a steel stand. Although it is not easy to see, the stand has four legs. The stand allows the catapult to be angled upwards. The rubber strands, pouch and tensioning wire can all be seen. (IWM)

According to the complete specification of the patent, the catapult was 'light and readily transported and capable of being set by hand to throw a bomb, grenade or the like by mechanical means without the aid of any charge or explosive'. Basically, it was an enlarged Y-shaped catapult familiar to all boys, with an elongated 'handle' or central beam and a bracing arrangement between the forked arms, all of which was constructed in wood. The specification recommended ash. Rubber springs attached to the extremities of the arms were joined together at the centre line of the beam via a canvas pouch for the missile. On the back of the pouch was a loop to engage a hook on the end of a tensioning wire that extended rearwards over the central beam to a pulley at the rear of the catapult. It went round this and back up the underside of the beam to a winding gearbox with a handle. Inside the gearbox was a drum around which the tensioning wire was wound by turning the handle. When the required tension in the rubber springs was achieved, a pawl in the gearbox was used to engage the teeth on one of the gears to prevent the drum from unwinding the wire. The hook was part of a simple trigger mechanism which when operated released the pouch which was then pulled rapidly forwards by the springs and the bomb was hurled away.

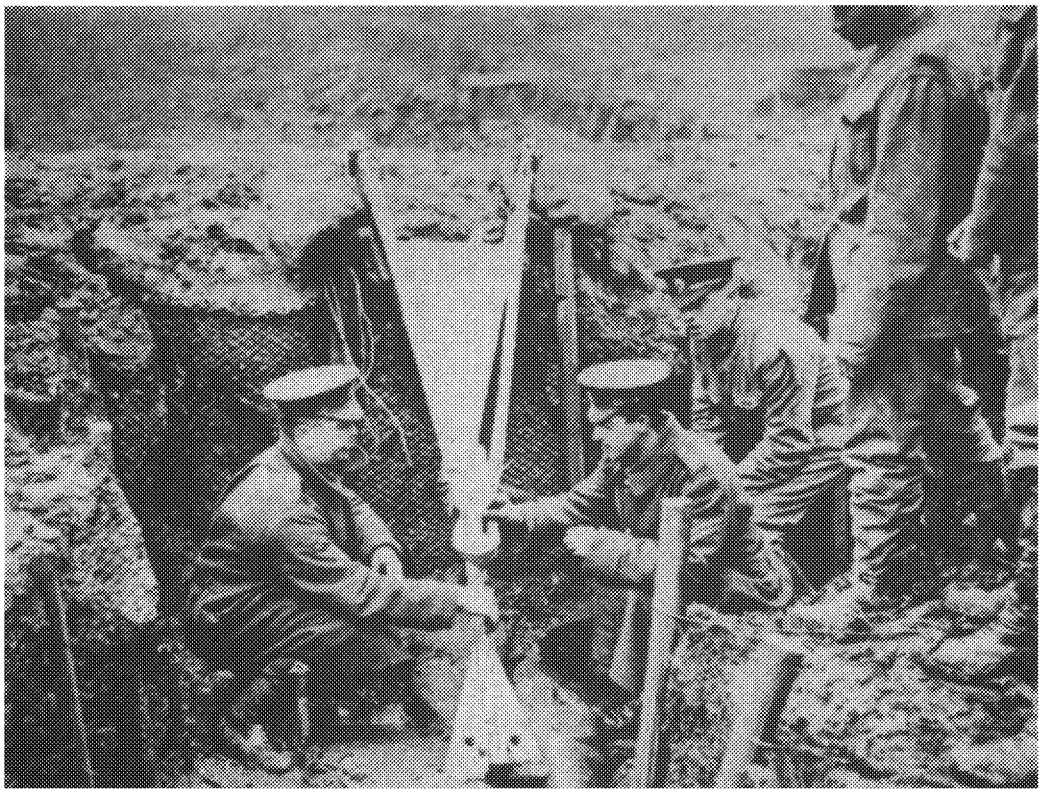
Although Leach had first taken his catapult to Jackson, the Experimental Section at Hythe also conducted trials with it. Captain Todhunter, the Experimental Officer, visited Gamage's works department in the late spring of 1915 to discuss the canvas pocket which was not



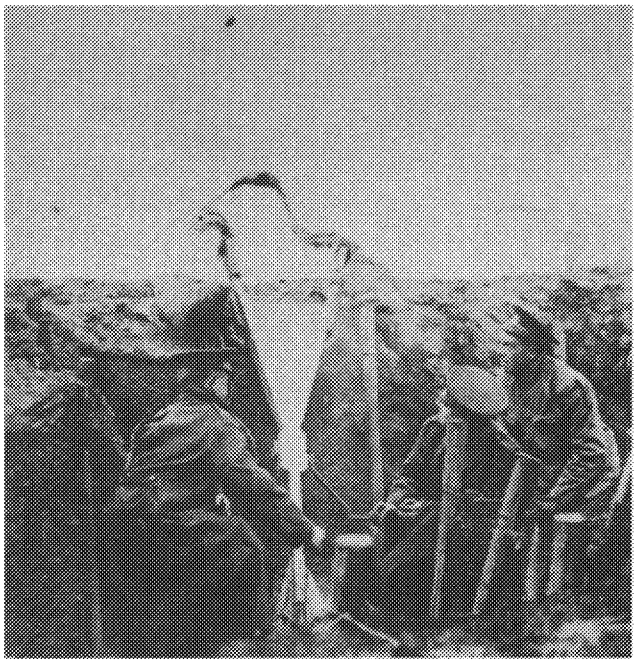
This photograph taken in the Dardanelles in 1915 shows a number of weapons and devices made by the engineers of the No. 2 Field Company, Royal Naval Division. In the centre is a catapult based on the Leach design. Two more are behind the man on the right. On the extreme left and extreme right are two mortars which were probably made from lengths of pipe. The one of the right has a Lee Enfield firing mechanism. What appears to be an improvised grenade is at the foot of the catapult stand on the left. In the centre is a sniperscope with an auxiliary stock for firing the SMLE from behind cover. The man on the left is armed with a rifled loaded with a No. 20 rifle grenade; the rifle has a pendulum sight just to the left of his right hand. (IWM)

performing well. A new design was produced and Todhunter reported that 'good results have been obtained' and recommended that the new pattern should be shipped out to France for use on all the catapults already in service. When twelve strands of rubber were used in each spring and the catapult was angled at 35°, four shots with an 18 oz bomb travelled 160 yd, give or take a yard, every time. Not that this was much of a distance.

Todhunter also recommended that the pouches should be printed with a range scale and that full instructions on how to use the catapult should accompany all new devices, which begs the question of why full instructions were not issued in the first place. In May the works department manager prepared a set of instructions which were subsequently sent out as CDS 20. These included such caveats as 'The rubber springs should be fixed so that no twists in the rubber springs exist' and 'the tail of the machine should be firmly fixed or butted against some hard substance, so as to avoid . . . any recoil from the time the trigger is released until the grenade has left the pocket'. He also advised that to decrease the range, rubber strands should be removed rather than reducing the extension of them because accuracy could only be obtained with a full extension. He also pointed out that the angle at which the catapult should be set was 41.5° (rather too precise for the trenches) and that in



Operating the Leach catapult. The man crouched on the right is lighting the fuse. Note the muddy conditions. (ILN)



The same catapult has just fired the bomb, which can be seen in flight. The top of the catapult is very visible above the parapet. (ILN)

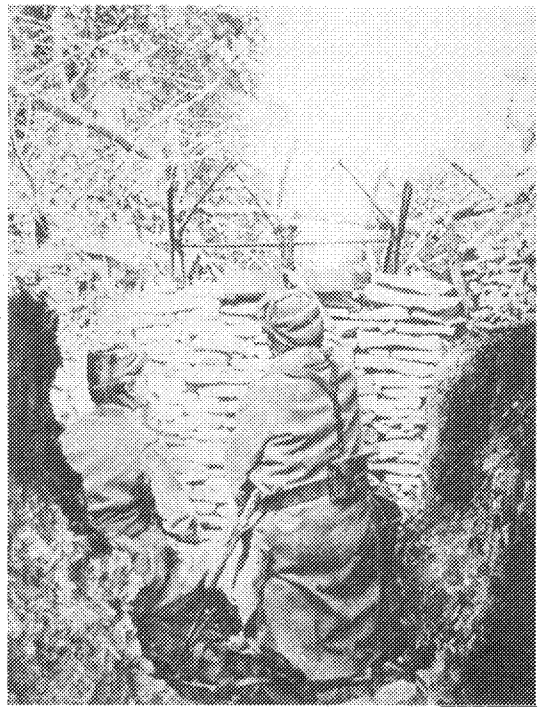
order to prolong the life of the rubber strands the springs should not be kept in tension for any longer than was necessary. From this, it is clear that there was plenty of room for error when operating the catapult and it is not surprising that things did not always go as planned.

One of the problems with any catapult that relied on pure natural rubber to provide the propulsive force was the degradable nature of unstabilized or unmodified rubber when exposed to the elements. In short, it perished. It was quickly discovered that the rubber soon lost its elasticity and acquired a permanent stretch which upset the optimum performance of the catapult. Moreover, the strands tended to break at inconvenient moments. The machine was fairly accurate when the rubbers were new but performance dropped off alarmingly quickly. Various 'preparations', a distinctly medieval sounding term, were developed to preserve the rubbers but none of them was really effective. The only solution to the problem would have been to use rubber that was at least partially vulcanized. The process of vulcanization produces chemical crosslinks between the coiled long-chain rubber molecules which not only hardens the material but helps to preserve its elastic properties by preventing the molecules from becoming uncoiled and from being cut up into shorter segments by the action of ultra violet radiation. The way in which the springs deteriorated and the fact that they did so quickly suggests that the rubber was not vulcanized. It is rather surprising that vulcanized rubber was not used since most rubber has always been cured in this way before use and the process was well known by the time of the First World War. Moreover, the works manager warned that 'it is essential that the rubbers . . . should be kept absolutely free from oil or grease of any description'; only unmodified rubber would be susceptible to deterioration by these materials.

When the catapult was producing its optimum performance, a bomb took 4.25 seconds to travel 75 yd. According to the works manager, the greatest distance one had hurled a bomb was 300 yd, the time of flight being a mere 5 seconds, the duration of a time fuse on a grenade and the ultimate factor in determining range. Generally, though, the catapults produced long flight times for short distances and gave the Germans ample time to spot a bomb in the air. However, the catapult had one advantage that no trench mortar could match: it was silent.

Although the heyday of the trench catapult was 1915, many remained in France long after they had been superseded by mortars. In the summer of 1916, Edmund Blunden came across a Gamage's catapult and since he had time on his hands to please himself to some extent he whiled 'away a foolhardy hour with a trench catapult ("Gamage's"), which . . . I discovered, would readily toss a Mills bomb far enough to burst as shrapnel over the huge crater in front of the German line'. This was a more foolhardy exercise than perhaps he realized, although he must have been aware that timing the release of the Mills' lever with the release of the catapult trigger, even with two people working together, was critical if a potentially fatal accident was to be avoided. In the days of 1915 when it had been used in earnest, the catapult had thrown bombs with safety fuses that had to be lit, a far more straightforward procedure when combined with firing a catapult than arming a Mills in its pouch just as it was about to be released, although special pouches to accommodate Mills grenades were supplied. Nevertheless, irrespective of the type of grenade fired by the catapult, a certain amount of coordination and practice was required if all was to go well. Blunden seems to have succeeded, however.

In May 1916, long after the catapult had ceased to be a front-line weapon in France, 300 Leach catapults were issued by the Trench Warfare Department for home use. This was a rather curious act since no catapult could substitute for a trench mortar for training purposes and the range of the catapult was so limited that it is hard to imagine who the enemy at home



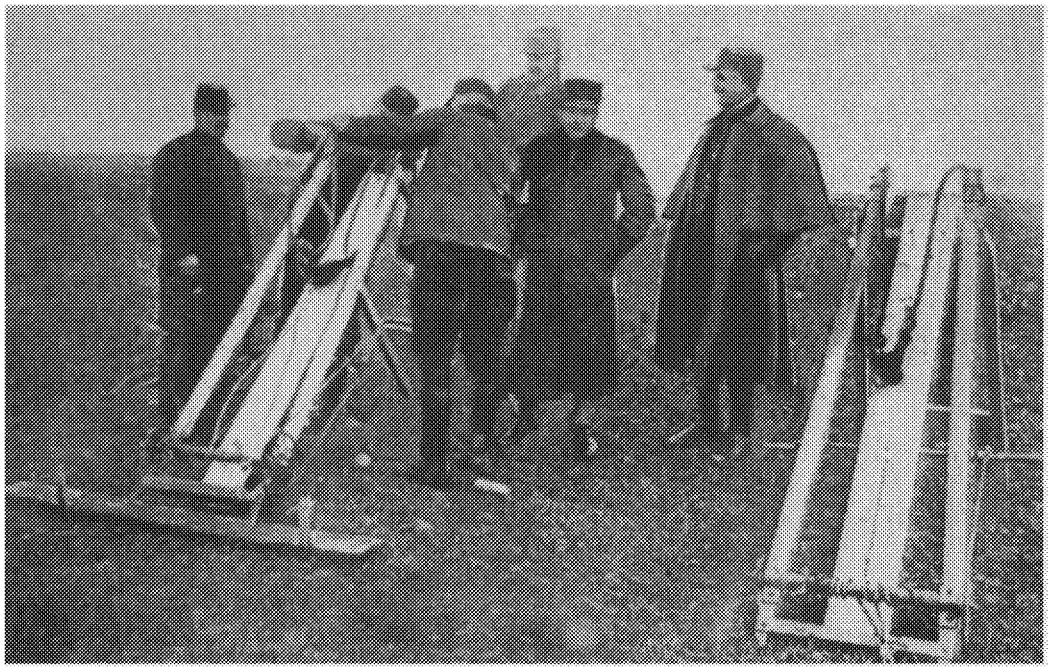
This French catapult had a very short range of about 90 yd. The soldier on the right appears to be about to fire it. (ILN)

A similar catapult loaded with a grenade. Note the winding handle on the right and what appears to be a seat. The man on the right has a basket of grenades. (ILN)

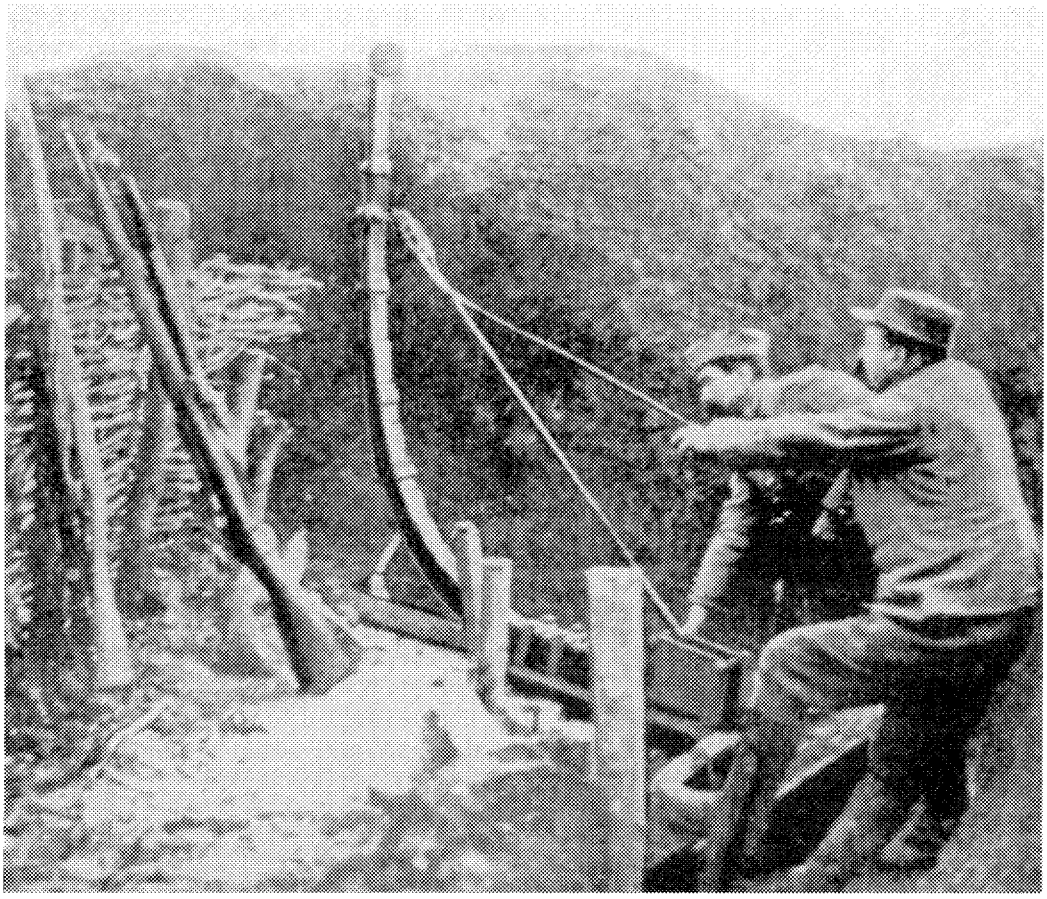
might be. The catapults could have served no useful purpose. In France, they had only ever been convenient substitutes for trench mortars until the supply of the latter increased. Even in July 1915 the catapult was already becoming obsolete. The Royal Welch Fusiliers came upon a Leach catapult at Red Lamp Corner where the German trenches were only 80–100 yd away, well within the range of the catapult. But instead of throwing bombs it was now 'used mainly for hurling abusive messages wrapped in clay'. Evidently, their predecessors in the line had been on friendly terms with the enemy.

The Leach or Gamage catapult was the only one to see British service, although other improvised contraptions appeared locally from time to time. Although the Leach catapult was light, it still needed two men to operate it so the Trench Warfare Department decided to experiment with a smaller version. This was designed by Captain Wicks and became known as the Wicks Baby Catapult. This would have been a good opportunity to have dealt with the problem of deterioration of the rubber bands by using more suitable material but they stuck with the same unmodified rubber and the problems remained. As a result, the Baby Catapult never saw service in France. How much use it would have been, however, is open to question since it had a range of only 100 yd.

The British were not the only ones to make use of catapults. Both the Germans and the French used them as well. These all appear to have been locally made improvisations, rather than officially adopted devices, on the lines of a Leach catapult but one type of French catapult must have been an official piece of equipment since the Trench Warfare Supply Department was asked to carry out trials with it at the request of GHQ, France. Some French contraptions bear a similarity to the Leach and may have been inspired by it although they



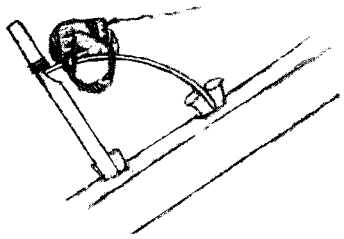
Two more French catapults from 1915. These use bicycle gears, chains and pedals for winding. They appear sturdier than other French devices and are probably improvised. From the casual appearance of the men, this must have been a demonstration well behind the lines. (The Times History of the War)



A French leaf spring catapult from 1915. Note the size of the pit needed by this device. (The Times History of the War)

appear to have been cruder; e.g. one was basically an upright double A-frame made of wood with a firing ramp between. It appeared to use bicycle gears and chain with a single pedal to wind back the rubber with a tensioning wire attached to the rear of the bomb pouch, the wire being wound on a spindle at the back of the machine.

Another French machine appeared to use half of a lorry leaf spring with some sort of mechanical winding gear to pull it back. This was about 5 ft long. It is difficult to see how this could have thrown a bomb into the air as from its construction it appears more likely to throw it at the feet of the operators, since the spring would end up horizontal without some sort of stop or buffer, which seems to be absent or located in the wrong place. A similar but smaller device was improvised by the British. This was a balk of timber with a piece of springy metal (part of a steel spring from a railway truck) held in a slot by hammered-in wedges. The short spring was no more than about 18 in long. It was pulled back by a rope loop and secured in a trigger. This was simply a length of wood with a notch in it to take the end of the bent back spring, held in another slot with more wedges. The timber balk was laid up against the parapet to get an angle but it is doubtful that the device could throw a bomb very far. Apart from the obvious size difference between this and the French leaf spring



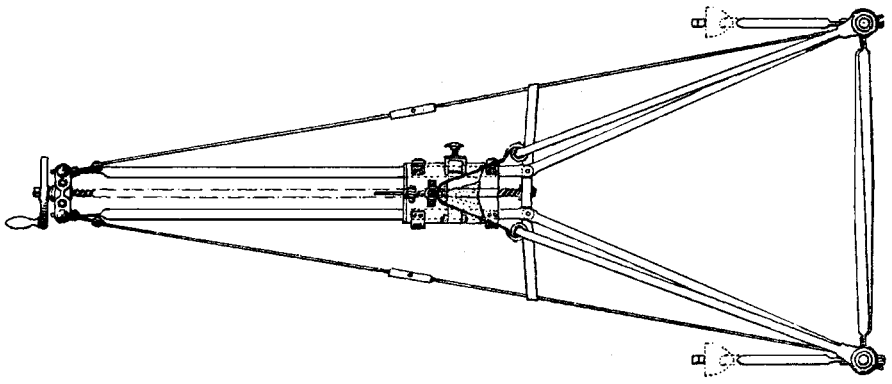
An improvised catapult made from a balk of timber and a length of spring steel. It is loaded with a Jam-Tin grenade. The upright stick was pulled back to launch it. The range was not much greater than a man could throw it unaided.

catapult, the most significant difference was the fact that the spring of the British one was secured vertically so that the spring formed a convex curve when in tension, whereas the French one was secured horizontally and formed a concave curve when in tension.

Only one other true catapult was patented in Britain but this was a much more complex machine than the Leach device which it resembled. This was UK patent 10,662/15, applied for on 22 July 1915. Unfortunately for the inventor, R.T. Glascodine, catapults were old news by then. The inventor had clearly attempted to devise an effective and portable machine that was less susceptible to the drawbacks that plagued the Leach machine but although it was made of tubular steel rather than wood it appears to have been much less robust than the Leach and less able to withstand the rough treatment it would have received in the trenches.

There was one other machine that used rubber as the motive force to propel a projectile: John Robertson's device, for which the inventor filed a patent application on 26 August 1915. This was subsequently granted on 28 August 1916 as UK patent 12,298/15. Like Glascodine, he had missed the boat. The motive behind the device was laudable. Robertson was a gunsmith who owned a business called Boss & Co. He wanted to produce a robust and compact catapult that would throw a bomb further and more accurately than previous catapults. He had thought about the problems of recoil and provided the device with springs or buffers to absorb the impact of the bomb-carrier as it reached the end of its travel when propelling a bomb. It was a more solid-looking device than Glascodine's but like Glascodine's it was far more complex than the Leach.

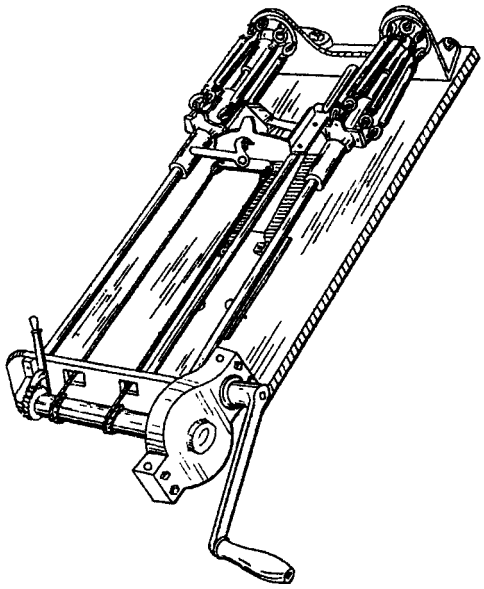
Altogether there were about eighteen patents granted to inventors of various sorts of catapult, including those discussed above, most of which were applied for in 1915.



Yet another patented rubber-spring operated catapult, this one made of tubular steel (Glascodine's patent 10,662/15). Note the anchors at the front and very long screw (dotted lines) between the winding handle and the bomb-carrier.

Specifications continued to be filed throughout the war, indicating that inventors were not always on top of current trends. The majority were mechanical 'spring guns', although the term gun was something of a misnomer since such contraptions were no more guns than the Leach catapult was a mortar. The only spring gun to enter service was the West Spring Gun which was under development at the same time as the Leach/Gamage catapult. The West Spring Gun was named after its inventor, a Captain West. This was a version of a Roman stone-throwing engine.

About the same number of West's device saw service in France as the Leach catapult. Guy Chapman was one of the unfortunate few who came into contact with one when his unit's bombing officer proposed using it to respond to German light mortar fire in late 1915. Chapman was more than a little sceptical of its value:



Robertson's catapult from UK patent 12,298/15. This worked on a similar principal to the Leach catapult. Note the banks of rubber springs.

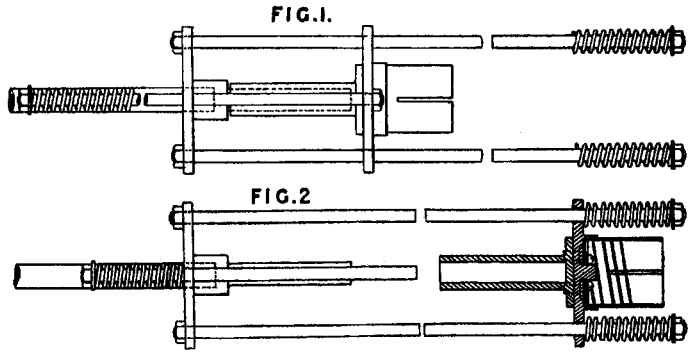
The West Spring Gun being demonstrated somewhere in England. The helmets suggest that this shot was taken in 1916 when the Spring Gun was no longer in service in France. The device is on a duckboard weighted down with sandbags. Note that it takes three men to pull back the throwing arm. Some of the springs can be seen at the front of the device. (IWM)

> It was supposed to hurl a hand grenade with much force and accuracy into the enemy's lines. In practice, it was much more apt to shoot the missile straight up into the air to return on the marksman's head, supposing he still possessed one; for the machine was also calculated to decapitate the engineer if he was clumsy enough to stand in front of its whirling arm.

He was not sorry to see it disappear into the mud produced by the winter rains. Edmund Blunden's unit contemplated resurrecting a West Spring Gun in 1916 which had long lain unused in a dump 'a legacy of the ingenuity of 1915, but antiquity was respected, and our lives may have been saved'. They left it alone to rust in peace.

The postwar 'Development of Weapons used in Trench Warfare' by Lieutenant-Colonel Brothers described the operating procedure for the gun. It was evidently used in similar circumstances to those under which trench mortars were used but it was limited by its range of about 240 yd. It was used mostly 'as a support to "cutting out" operations, and was not used in general work'. The reason it remained in service was its great accuracy and its silence. It was heavy, bulky and inconvenient to move from place to place. Moreover, it required an emplacement 8–9 ft square which was considerably bigger than that required by a trench mortar, but worse than this was the fact that the cocking lever was often visible above the parapet. It is not altogether clear how the gun functioned other than by the combined action of twenty-four springs, distributed in banks of equal size, on a throwing arm. Setting up the gun was something of a rigmarole.

> The ground had to be as level as possible. Then by means of carrying rods, the gun was carried into position. The sandbag boards were then unstrapped and fixed in position on each side, 13 or 14 sandbags being placed upon each of them. The throwing arms were then put in with the straight side up. It is advisable not to tighten the holding shoes till the bomb cup is affixed.



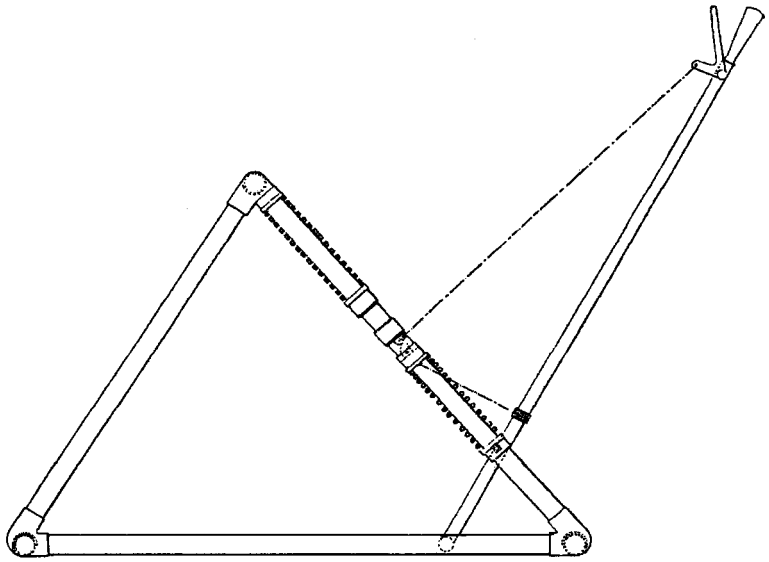
M.E. Brett's spring bomb-thrower (UK patent 10,165/15). This odd-looking object was attached to the muzzle of a rifle and the bomb was discharged by a blank which acted on a rod inside the barrel. The bomb-carrier is between the two guide rods fitted with compensating springs. The carrier also contains a spring to help the grenade on its way. The recoil would have been severe. Top: *normal position.* Bottom: *fired position.*

Although there were two types of cup, one for percussion grenades, the other for time-fused grenades, only the V-shaped cup for the latter was generally used. The V in the wooden block prevented the grenades from rolling off the machine – these were mostly spherical bombs – a serious hazard to the operators and anyone near by.

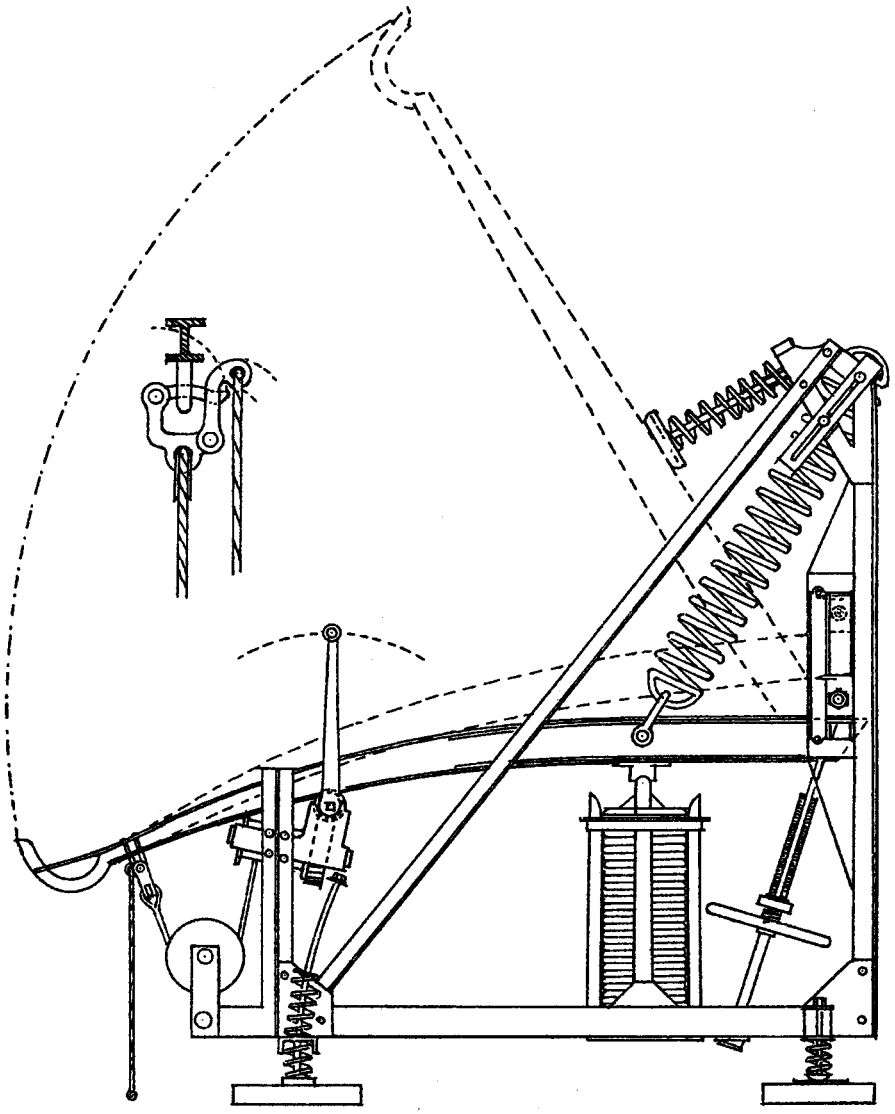
> There is also an elevating screw for varying the height of the trajectory. The screw acted almost in the same way as the fingers of a throwing hand, decreasing the height of the trajectory as it is lengthened and vice versa. The knuckle of this screw must be at right angles to the surface of the bomb.

There was a two-piece cocking lever. The gun could be ranged in three ways, the most common being the raising or lowering of the trigger 'that is, if the trigger is lowered, the throwing arm would have to come farther down, thus increasing the tension, and giving longer range'. The second method was to alter the height of the elevating screw on the bomb cup to give a higher or lower trajectory. In practice, the range was altered by a combination of these two methods. The third alternative was to remove or add springs but this was not a simple process. The gun could be traversed only slightly by slewing it round on its bed which required the securing bolts to be slacken off. Traverse was limited to 15 yd in every 100 yd.

Lieutenant-Colonel Brothers' report affords only a glimpse of the West Spring Gun and does not reveal its construction. There are several patented devices dating from late 1914 and early 1915 which resemble the West device but none of the inventors is named as West. An application filed on 25 November 1914 to become UK patent 23,044/14 on 2 September 1915 bears a strong resemblance to it although it differs in some important ways. The inventor was described in the document as an architect, one Matthew James Dawson. It operated on a similar principal to the West device except that whereas the Spring Gun relied on one set of the springs arranged in banks the Dawson device used two sets of springs so that when the apparatus was

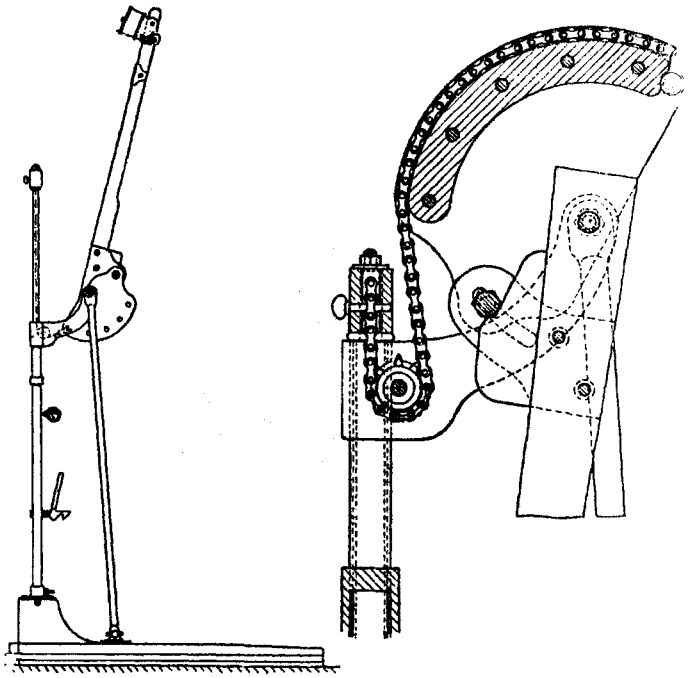


J.A. Hill's 'spring projector for bombs, grenades, and like missiles', UK patent 106,656. The device was supposed to be secured to the ground by 'anchoring-spades' (not shown).



Dawson's spring projector made of steel with banks of springs above and below the throwing arm (UK patent 23,044/14). Note the buffer to arrest the forward movement of the arm. Details of the trigger located below the end of the arm are shown in the inset. Note that the arm was intended to be flexible and provide some of the throwing energy.

cocked one set was under compression while the other set was under tension. A similar approach was adopted by J.A. Hill in 1916 with his patented spring-operated bomb-thrower (106,656 and 107,045). Although this appears to be a robust, workable contraption, it is highly improbable that the Army would have been interested at that late date. A bomb-carrier was retracted along two inclined guideways against the action of propelling springs using a long lever. A trigger on the lever released the carrier and propelled the grenade into the air.



A pneumatic bomb-thrower with a difference – a bicycle chain. Drawings from UK patent 12,291/15 granted to A. and G. Wood. The cylinder and piston at the front form the pneumatic part. The piston is connected to the throwing arm by the chain. Note the pressure gauge midway down the cylinder and the catch below this to hold the cocked arm.

The West Spring Gun was manufactured by the Reason Manufacturing Company which also developed a grenade fuse although it does not appear to have been used. It filed for a patent on 19 October 1915 and this became UK patent 14,793/15. Another company, A. West & Co. of Brighton, also manufactured the Spring Gun but it is not clear whether this West was related to the inventor.

Special bombs were manufactured for catapults and Spring Guns, although sometimes the only difference between the hand-thrown variety and the catapult and Spring Gun variety was a longer fuse for the latter to ensure that it reached the target before the fuse burned down to the detonator. These bombs tended to be spherical although Jam-Tins and Lemons were often fired from them but mostly they were No. 15 Ball grenades with 9-second fuses. In August 1915 'Special Bombs' were ordered for the West Spring Gun from the manufacturer but Jackson complained that samples had been late in arriving for his department to test, which had delayed the placing of the order. 'The Company had been repeatedly pressed for a sample, but caused great delay by sending them unofficially to the front by Captain West.'

In November 1915 the Director General of Trench Warfare Supplies informed the Director of Artillery that although the supplies of grenades for catapults in France and Gallipoli were inadequate, a supply of 100,000 Ball grenades per week could now be guaranteed, a quarter of them going to Gallipoli, the rest to France. The supply of Ball grenades for hand throwing had been discontinued.

In addition to these, 40,000 D grenades per week could also be supplied, presumably in similar proportions as the Balls to the respective theatres. The D grenade was a 4 in diameter spherical bomb made of tin containing 19 oz of ammonal. Whereas the No. 15 was a fragmentation grenade the D was a blast grenade, producing very little shrapnel. There was also a small supply of E grenades (No. 33) which were, in effect, 3 in diameter versions of the D containing 8 oz of ammonal. The supply was shortly expected to rise to 40,000 a week. All these grenades had Brock igniters to overcome the problem of wet weather.

On 17 February 1916, 10,000 3.75 in diameter spherical R grenades were ordered for the West Spring Gun. Already, 150,000 were waiting to be filled with explosive and by March a total of 500,000 were on order. However, those already made but unfilled ended up being put into storage as GHQ was having second thoughts about the wisdom of supplying grenades for catapults and Spring Guns which were being phased out. On 14 March 1916 the requirement for catapult and Spring Gun ammunition was cancelled and Lieutenant-General Maxwell wrote to the Army Council to state that the 3 in Stokes would replace the catapults and bomb-throwers. On 13 July the Leach catapult and the West Spring Gun officially became history when they were dropped as service equipment by the War Office.